

DOCUMENT RESUME

ED 259 673

HE 018 601

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TITLE Designing a Decision-Support System for Enrollment Management. AIR 1985 Annual Forum Paper.
PUB DATE May 85
NOTE 24p.; Paper presented at the Annual Forum of the Association for Institutional Research (25th, Portland, OR, April 28-May 1, 1985).
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Persistence; College Administration; *College Admission; College Applicants; College Planning; *Computer Oriented Programs; Computer Software; Decision Making; *Enrollment Projections; Higher Education; Institutional Research; *Management Information Systems; Marketing; Student Characteristics; Student Financial Aid; Student Needs; *Student Recruitment; Systems Development
IDENTIFIERS *AIR Forum; *Decision Support Systems; University of Hartford CT

ABSTRACT

University of Hartford's decision-support system for enrollment management, which uses fourth-generation software tools, is described, with attention to the conceptual framework, design and implementation plan, and progress to date. The university's planners, institutional researchers, and admissions and financial aid officers are cooperating in the development of a distributed processing strategy for enrollment management in order to satisfy operational reporting and decision support requirements. The use of EASYTRIEVE PLUS, a user-friendly report generator, and ADDS III, an application development system currently programmed in dBASE III, is discussed. In addition to noting ways to predict the prospective applicant population, attention is directed to approaches that can be used to identify competitor schools and the university's image in student recruitment. Additional components of the enrollment management system are covered: market selection and direct mail applications, evaluation of recruitment strategies, forecasts of enrollment and student flow, academic prediction, prediction of admission yield, data on student characteristics, student need/satisfaction surveys, student financial aid, student retention, instructional income and revenue, and alumni follow-up. (SW)

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DESIGNING A DECISION-SUPPORT SYSTEM
FOR ENROLLMENT MANAGEMENT

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Presented to
The Association for Institutional Research
Twenty-Fifth Annual Forum
The Portland Hilton
Portland, Oregon
April 28-May 1, 1985

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This paper was presented at the Twenty-Fifth Annual Forum of the Association for Institutional Research held at the Portland Hilton in Portland, Oregon, April 28-May 1, 1985. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum papers.

Elizabeth F. Fox, Chair
Forum Publications Editorial
Advisory Committee

DESIGNING A DECISION-SUPPORT SYSTEM FOR ENROLLMENT MANAGEMENT

Colleges and universities are going to need a flexible and responsive Decision-Support System (DSS) for enrollment management to cope with the threats of declining enrollment and financial stress in the decade ahead. This is especially true for institutions located in the Northeast where the number of high school graduates is expected to decline by nearly 30% between 1983 and 1993 (WICHE, 1984).

During the past two years, the Office of Planning and Institutional Research at the University of Hartford has been working on ways to build an effective decision-support system for enrollment management using fourth-generation software tools. This paper reviews the conceptual framework, design and implementation plan for the system; and it summarizes the progress we have made and what we have learned to date.

THE POTENTIAL FOR ENROLLMENT MANAGEMENT:

Efforts to synthesize the literature of enrollment management have increased dramatically since the early 1980's (Hossler, 1984, Kemerer, et al, 1982, Baldrige et al, 1982, Ewell, 1984, Pascarella, 1982). Enrollment management has been defined as any institutional attempt to influence the number, mix, and quality of students through recruitment and retention strategies. For highly selective colleges and universities, the concern in enrollment management is recruiting a student body of high quality which has a distinctive set of valued characteristics. For many less selective institutions, enrollment management is necessary to attract students in sufficient numbers to enable the institution to survive, to maintain its academic vitality and to achieve fiscal stability (Hossler, 1984, p.1). In today's rapidly changing, uncertain and threatening environment, higher educational institutions can only influence; they certainly do not have complete control over the size and quality of their enrollments. Many external factors are significantly beyond the institution's control -- the number of high school graduates, the percentage of graduates

deciding to attend college, institutional pricing in public universities and community colleges, government policies on student financial assistance, shifting employment opportunities and changes in student curriculum preferences. In competing for a shrinking supply of academically qualified students, colleges and universities that have tradition, academic prestige, satisfied students, successful alumni and substantial endowments, physical plants, and annual giving have a distinct advantage. Institutions that have a concentrated dependence on tuition income, a high ratio of acceptances to applicants and a low ratio of enrolled to accepted students (i.e., admissions yield) are much more vulnerable to economic and demographic trends

Hossler, in his recent review of enrollment management literature and case studies, concluded that:

well conceptualized plans to manage enrollment can lead to a better institutional self-understanding and an enhanced institutional health and vitality. With adequate information about the institutional environment and sufficient data about the actual and potential markets of a college or university, enrollment managers may indeed be able to influence college choice effectively (Hossler, p.148) (Kemmerer, Baldrige, and Green, 1982) (Muston, 1984).

Computer searches of the enrollment management literature in ERIC and CIJE, performed annually at the University of Hartford have been very productive in identifying: conceptual frameworks (e.g., Tinto, 1982; Rowse & Wing, 1982); literature reviews (e.g., Pantages & Creedon, 1978; Lenning, 1980; Ramist, 1981; Hilton, 1982); exemplary enrollment-management research studies (e.g., Litten, 1983; Lay, 1982; Pascarella, 1981; Terenzini & Pascarella, 1978; Lay & Maguire, 1978; Bean, 1981) and action-research strategies for student retention (e.g., Finkelstein, 1983; Beal, 1980; Lenning, 1980; Baldrige, 1981; Kemmerer, Baldrige & Green, 1982).

GOALS FOR ENROLLMENT MANAGEMENT:

- 1) Increase the accuracy of enrollment and income forecasts.

- 2) Seek ways to increase the University's market share of prospective applicants.
- 3) Ensure that institutional pricing and student aid policies are competitive with comparable institutions.
- 4) Within the limits of available resources, offer high quality academic programs and campus experiences which are responsive to the needs and preferences of students.
- 5) Seek ways to increase admissions-yield from the number of accepted applicants.
- 6) Maintain academic standards and an enrollment mix which is consistent with the University's mission as a private, comprehensive institution.
- 7) Find ways to describe, predict and improve student retention.
- 8) Balance instructional staffing, and income and expense at realistic levels, considering both academic values and enrollment demand.
- 9) Follow up and report on the achievements and satisfactions of students and alumni.

UNIVERSITY OF HARTFORD:

Strategic choices and effective enrollment management are going to be critical to the survival, growth and improvement of the University of Hartford over the next two decades. Established through the merger of Hillyer College, the Hartford Art School, and the Hartt School of Music only twenty-seven years ago, the University of Hartford has grown rapidly and become an extremely complex institution for its size, with about 4,000 full-time and 4,000 part-time students. As the University's enrollment grew, its academic programs, staffing, physical plant and annual operating budget also increased; and its student clienteles, academic programs and administrative structures became increasingly diversified. However, the University is now vulnerable to threats of demographic decline and financial stress because it has only limited endowment and annual giving per student, it accepts a relatively high percentage of its admission's applicants and it has a concentrated dependence on enrollment income and government-sponsored, student-aid programs as sources of revenue. Moreover, the external environment in which the University operates has become increasingly turbulent over time and it is likely to remain that way for at least another decade.

APPLICATION DEVELOPMENT FOR DECISION SUPPORT:

How does the strategy of building a Decision-Support System for enrollment management differ from approaches traditionally used in developing a management information system or an institutional-research program?

Much has been written about the concepts of Decision-Support Systems, the Information Center and Fourth-Generation Software approaches to application development (e.g., Briggs, 1981; Goetz, 1982; Keen, 1981). Decision-Support Systems use interactive computing as tools to help executives and managers to gain access to information needed to inform their own intuition and judgement and to make better and more timely decisions. On-line retrieval of information from the database is through interactive computing which is user-friendly, flexible and responsive to ad hoc requests for information. Information from multiple data sources, both external and internal, are integrated to prepare analytical reports and planning scenarios.

Requirements for a comprehensive, integrated Decision-Support System include: 1) user-friendly retrieval for inquiry and report generation from the operational database; 2) model building tools to ask "what if" questions; 3) a common data dictionary and interfaces between report generation and statistical analysis packages; 4) electronic filing, communication and retrieval of executive summaries, spreadsheets and graphical displays; 5) information-center support distributed through education, consulting and software to end-users.

The University of Hartford has made a substantial investment to increase the efficiency and quality of its administrative computing operations using application software purchased from Systems and Computer Technology Corporation (SCT). SCT application systems were implemented using COBOL as the host language and the IBM Customer Information, Control System (CICS) and CINCOM Systems TOTAL as the database management system. As a transaction processing system, SCT application software is extremely efficient in creating, updating and retrieving individual records for students, courses, faculty and funds. Unfortunately, the application software we have purchased lacks the flexibility and responsiveness necessary to satisfy our requirements for decision-support and enrollment management at the University.

The Office of Planning and Institutional Research and the Office of Admissions and Financial Aid at the University are cooperating in the development of a distributed processing strategy for enrollment management which is designed to satisfy many operational reporting and decision support requirements.

The first problem we had to solve was how to offer users easy and convenient access to the operational databases for admissions, financial aid and student records stored on the IBM 4341 mainframe. Computer Services staff at the University have identified a promising way to link data file transfers from the IBM mainframe to the IBM Personal Computer (IBM-PC). The approach seems practical, efficient, and cost effective and it minimizes security and integrity risks in offering access to operational databases on the IBM mainframe.

EASYTRIEVE PLUS, a user-friendly report generator, is used to select records and to format data fields selected from multiple data files on the operational database to sequential magnetic tape files for down-loading to the IBM-PC. A data dictionary was built using EASYTRIEVE macros to link the names of the data fields requested in the download to the logical structure of records stored in the TOTAL database.

Data extracts are performed during routine batch processing runs with download data retrieved to magnetic tape in the form of transaction records or replacement files. Data file transfer takes place off-line through a hardware device that reads records from magnetic tape into a Bernoulli Box cartridge, a portable cartridge which contains 10 megabytes of disk storage. When the cartridge is plugged into the Bernoulli Box device on the IBM-PC, the database the admissions office wants for enrollment management is ready for reporting and statistical analysis.

For nearly two years, the Office of Planning and Institutional Research has continued to design and program an application development system for decision support (ADDS III) in a distributed processing environment. It is a user-friendly structure of menus, screens and programs which interfaces fourth-generation software products to enable users to satisfy their own information requirements with a minimum of programming assistance.

The current version of ADDS is programmed in dBASE III, a powerful procedural programming and interactive query language. Using downloaded data in the mainframe's logical structure, ADDS III was used to model the database on the IBM-PC to determine what data file structures would satisfy our information requirements for enrollment management most efficiently. Six primary database structures were defined based on student sub-populations and reporting requirements: 1) applicants for admission; 2) prospective applicants for admission; 3) financial aid applicants; 4) characteristics of entering students; 5) summary academic history for enrolled students; 6) course enrollment demand.

The ADDS III data dictionary is created from an active dBASE III dictionary. The ADDS III dictionary in turn is used to generate an SPSS/PC directory and to provide a cross-reference to EASYTRIEVE data field names used in the macro directory on the IBM mainframe.

Because ADDS III is built using fourth-generation software products, information requirements for enrollment management can be satisfied interactively in a prototyping environment. Following preliminary discussions, and while the admissions staff was away on a three-week recruiting trip, our staff built an initial prototype of the enrollment management system. Upon their return, we worked together with admissions office staff members on the IBM-PC to change, refine and expand the available report options. The cross training benefits of prototyping were immediately evident; we learned more about the information needs of the admission's office, while they learned how to retrieve the information they want with minimum technical assistance.

Once the data directory is created, users only have to refer to the names of data files, indexes and data fields to process information requests. ADDS III provides screens for maintaining the data dictionary; for entering report codes, titles and dates; for selecting sorting and indexing records; for extracting and updating data files; for preparing listings, labels, letters and tabulations, for performing computations and for specifying statistical analysis routines in SPSS/PC.

ADDS III programs interface and complement several of the leading decision-support software products available on the IBM-PC. PROKEY and the Fixed Disk Organizer create menus and screens which enable users to gain access to DSS software and databases. The decision support software consists of: 1) dBASE III for database management and report generation; 2) SPSS/PC a statistical analysis system; 3) LOTUS 1-2-3 for model building and graphics; 4) ABC for processing survey data, and 5) MULTIMATE for word-processing.

ADDS III makes provisions for producing reports either directly from dBASE III files or by transferring files to SPSS/PC for statistical analyses. SMARTER/PC, a telecommunications package is also available to transfer data files to the DECVAX 11-780 which has SPSSx, BMDP and SAS statistical analysis packages available.

The distributed processing strategy outlined above is being implemented using a maximum configuration IBM-PC with 624K storage capacity, a Bernoulli Box containing two 10 megabyte disks of portable storage, a laserjet printer or high speed impact printer and communications links with the IBM mainframe and DEC/VAX minicomputer. EASYTRIEVE PLUS and EZ/KEY also are required for report generation; and we have recommended the acquisition of the SAS statistical analysis system for the IBM mainframe.

ENVIRONMENTAL ASSESSMENT:

The Office of Planning and Institutional Research prepares Executive Summaries and factual data on enrollment trends for the President's Budget Advisory Team. The Budget Advisory Team recommends budget policies and strategic choices to address enrollment-management and resource-allocation needs.

Projections of the number of high-school graduates from the University's primary and secondary market states (i.e., Connecticut, New York, New Jersey, Massachusetts and Pennsylvania) were obtained from "High School Graduates Projections for the Fifty States 1982 - 2000." (WICHE, 1984). A composite table and graph were presented to show the annual percentage change in the number of high school graduates between 1983-1993, indexed to the base year, 1983.

From Admissions Testing Program (ATP) Summary Reports and the Enrollment Planning Service of the College Board, data are gathered on a continuing basis describing the prospective applicant population in each region and those who send SAT scores to the University. Reports provide norms for the New England and Middle States regions and for each state and geographic segment from which the University receives SAT scores. Information we gather yields comparison data for SAT scores and class rank, family contribution and financial need, the University's market-share, SAT overlap with other institutions and the curriculum preferences of prospective applicants.

The Enrollment Planning Service reports the number of prospective students sending SAT scores primarily to local, in-state, regional or national institutions in the University's primary and secondary markets in each College Board region. There is also a projection of the number of prospective applicants and the market share the University would have to obtain to maintain the same volume of prospective applicants over the next three years. Using a College Board market area and zip code, cross-reference table, the University can track its admission's yield from prospective student markets, to applicants, to enrolled students in each geographic area.

ANALYSIS OF INSTITUTIONAL COMPETITION:

The University has to balance institutional pricing and student-aid at competitive and realistic levels taking into account the value image of the University's academic and extra-curricular offerings, as perceived by students and parents. Which institutions to select as an appropriate frame of reference is an issue that is frequently raised in enrollment-management discussions.

Data on enrollment size, admissions selectivity, institutional pricing, student aid and curriculum offerings are readily available from such sources as the College Board Handbook, the Chronicle Data Service and the Beta Club Fact Book. To identify institutional competitors that are comparable to the University of Hartford, a cluster analysis was performed on data for forty-five northeast institutions using undergraduate enrollment, number and percentage of applicants accepted,

percent of applicants enrolled, average SAT Verbal and Math scores and total student costs as variables.

The University of Hartford clustered together with medium-sized comprehensive universities of moderate admission selectivity which, with the exception of a few public institutions, had relatively high student costs. The remaining clusters were identified as 1) Ivy League universities; 2) selective liberal arts and engineering institutions; 3) public (flagship) state universities and major private-comprehensive universities; and, 4) private colleges with special missions; e.g., Rhode Island School of Design, Julliard School.

Using data from College Board and Beta Club Fact Book cost surveys, the University monitors trends in tuition and fees, room and board and total student costs on both a current and cumulative basis for each institutional competitor. An institutional pricing spreadsheet (Lotus) reports the annual percentage increase and cumulative percentage increase in costs over a five-year period, indexed to comparable prices at the University of Hartford. Sorted listings of institutional competitors' student costs are prepared to show the University of Hartford's ranking on student costs relative to clusters of institutions and specific institutional competitors.

ACCEPTED APPLICANT SURVEYS:

The accepted applicant survey is another way to analyze the University's competitive position and image in student recruitment. (e.g., Litten, 1983; Lolli & Scannell, 1983; Lay & Maguire, 1978) The University of Hartford questionnaires asked accepted students to indicate where they applied and were accepted for admission, whether they applied for and received financial aid and how much financial assistance they received. Comparative data on University image was gathered asking students for their perceptions about differences which may have been factors in their college choice (e.g., distance from home, quality of student body, costs, financial aid, attractive campus). Other questions in the survey asked about the quality of admissions publications, impressions from contacts and visits and sources of information having a positive influence on the student's college choice.

The rate of return from the 1984 Survey of Accepted Applicants at the University was disappointingly low (about 20%). The questionnaire obviously has to be reduced in length and complexity and administered as short-form surveys to encourage a higher response rate. We must also consider the possibilities that: 1) accepted applicants are saturated with this type of marketing survey; and, 2) the University may not get as high a rate of return as some more prestigious colleges and universities have experienced.

MARKET SELECTION AND DIRECT MAIL APPLICATIONS:

At the University of Hartford, every college operates in a different market place; market structures, enrollment demand, the number and quality of student applicants, admissions selectivity and admissions yield all vary quite markedly. The enrollment management system has routines for segmenting the markets in each college, tracking students through changes in admissions status, assessing the volume of applicants and yield by market segment and evaluating the academic quality of students in any market segment.

The record selection and indexing features of ADDS III enable the user to segment markets within each college by: 1) College Board market area, state, and zip code 2) College Board high school code 3) preference for major field of study or 4) any other combination of data fields in the database.

Using view screens or printed reports, the admissions officer can model admissions yield and academic quality directly from the downloaded database, changing his selection criteria, indexes or ranges of values to assess the number and quality of students a college gets from any defined market segment. Having identified a market segment that has potential, the admissions officer can use ADDS to retrieve a report which identifies students in that market segment. The report may be a view screen or listing containing user-specified data fields, tabulations, statistical profiles, or a customized letter or labels for sending promotional materials.

Direct mail applications are implemented using the ADDS record-selection and indexing features to select name and address records for applicants in a defined market segment. The letter writing program converts upper-case names and addresses to upper and lower case format; it formats salutations and address fields and it converts codes in the student's record to text for letter and label insertions. Letters are produced using the merge-file facility of MultiMate (wordprocessing) software; and Labels are prepared using the label facility in dBASE III. The letter program records a code and date in the applicants record for each letter that is sent. Listings and admissions status counts are produced for each market segment using dBASE III's report facility. SPSS/PC is used to prepare cross-tabulations and statistical profiles for each market segment.

EVALUATION OF RECRUITMENT STRATEGIES:

Data on prospective applicants and admissions applicants can be matched in the system to associate recruitment strategy data with academic and market segment variables and with admissions status variables. The prospective applicant's academic preferences and extra-curricula interests are recorded in the recruitment record along with codes for letters and materials sent, and for recruitment contacts made with the student (e.g., campus visit, school visit, alumni meeting, special letter-honors student, basketball coach). Using multiple-response cross-tabulations, available through the SPSSx MULT RESPONSE procedure, with admissions status and academic predictors as criterion measures, the number and quality of prospective applicants who enroll can be evaluated for any given combination of recruitment strategies.

FORECASTS OF ENROLLMENT AND STUDENT FLOW:

An application flow model has been developed for the Admissions Office to monitor year-to-year changes in the number of applications, acceptances, rejections, referrals, withdrawals and tuition deposits received in each college. Data printed in the Admissions Status Summary Report are keyed into the application flow model on a bi-weekly basis. Summary data from the preceding year are combined with the current data through a LOTUS model to calculate percentage changes in application flow, the ratio of acceptances to applications and the ratio of tuition deposits to acceptances.

For applicants denied admission to their preferred college but referred to another college at the University, a three-way cross tabulation is produced using SPSS/PC. This report crosstabulates the number of students referred from one college to another, with separate tables for students who enroll and those who decline our admissions offers.

On the census date for each academic term, the Registrar's office prepares a rollup of enrollment statistics for each college, including summaries of student head counts and student credit-hours for all categories of students by undergraduate/graduate, full-time/part-time, by academic level, by sex, by day/evening and for non-matriculants. Standard sort breaks are programmed in COBOL to prepare separate analyses by foreign country, state, ethnic group and major; this provides adequate flexibility for satisfying mandatory HEGIS and state reporting requirements. However, more flexibility in selection criteria and sort breaks is required to satisfy our internal enrollment management requirements. Using EASYTRIEVE PLUS for record selection and sort breaks in combination with the existing COBOL cross-tabulation program, gives us the additional flexibility we need with a minimum amount of reprogramming.

The University of Hartford's Enrollment/Financial Planning Model integrates historical trends and forecasts of student flow with student credit-hour production, institutional prices and student aid to forecast all enrollment-driven income. Because each college at the University recruits students from a different marketplace and because patterns of stability in student flow vary widely among the colleges, an enrollment/financial planning model is also being developed at the college level.

The Instructional Work Load Matrix and Induced Course Load Matrix have demonstrated their value for curriculum planning and balancing faculty work loads with enrollment demand (NCHEMS, 1971, p17,p59). The Instructional Work Load Matrix cross tabulates the number of semester credit hours attempted in each department (or academic discipline) by course level with each type of student major (degree program) by student level (i.e., upper or lower division, or freshman, sophomore, junior,

senior, graduate student) Total semester credit hour production for each department and course level is determined by summing rows of the matrix, and for each major and student level by summing columns of the matrix. The Induced Course Load Matrix shows the number of credit hours in each department (or academic discipline) taken by the "average" student enrolled in each degree program in the institution. When a given set of enrollment projections by major is multiplied through the Induced Course Load Matrix it results in a forecast of the total credit hour load anticipated for each academic department or discipline at the University. Significant increases or decreases in enrollment demand have to be monitored to allow sufficient lead time to make adjustments in curriculum, faculty work loads and staffing levels.

ACADEMIC PREDICTION:

Traditional academic prediction studies are updated annually for each college to derive the optimum combination of SAT scores and high school class rank for predicting college-freshman grade point average.

With the exception of the College of Basic Studies, which has an open-door admissions policy, academic predictions for each college are sufficiently accurate (multiple correlations range from .52 to .68) to use in admission selection, identifying students for honors or remedial programs and selecting financial-aid recipients. The predicted college-freshman grade point average is also a critical variable used in prediction-of-yield and student-retention studies.

Taking the mean difference between predicted GPA and college GPA also provides a means of assessing admissions selectivity and academic performance for various student subgroups by high school, sex, resident, commuter, financial-aid recipient, etc.

PREDICTION OF ADMISSION YIELD:

To improve admissions yield, the University not only has to monitor each college's yield trends, it also has to analyze what types of students are more or less likely to enroll if accepted.

At the descriptive level, we prepare cross-tabulations for each college, including the number and percentage of accepted/enrolled and accepted/withdrawn students for such predictors as predicted GPA, geographic proximity of home, sex, financial-aid category, freshman/transfer, resident/commuter and levels of scholarship aid awarded.

Increasingly sophisticated analytical methods are now being applied to the problem of admissions yield (e.g., Lay 1982; McLain, 1984). A prototype research design for prediction-of-yield, which we plan to implement this fall, uses the method of stepwise-logistic regression. The criterion is a dichotomized variable: whether the accepted student enrolls or withdraws if accepted. Predictor variables combine both continuous and discrete variables: predicted GPA, geographic proximity, sex, financial aid, resident/commuter, scholarship aid awarded, high school type, freshman/transfer.

Maximum likelihood estimates of the parameters are derived introducing each predictor in a stepwise analysis or in combinations of predictors in a set-wise analysis. The analysis method yields estimation results in the form of coefficients which can be used: 1) to interpret the relative contribution of predictors in forecasting yield; and, 2) to calculate the probability that an individual student will enroll if admitted. For administrative and budgetary purposes, the aggregate forecast of the number of enrolled and withdrawn students can be obtained for any market segment in the accepted applicant population. The accuracy of predictions is assessed by comparing predicted with actual classifications of students on the enrolled/withdrawn dimension (McLain, Vance & Wood, 1984).

STUDENT CHARACTERISTIC'S DATA:

Through the ACE/UCLA Cooperative Institutional Research Program, (CIRP) the University administers the Student Information Form questionnaire and receives a descriptive profile of entering students in each college. Trends in student characteristics and comparisons with national student norms are interesting but not much value for purposes enrollment management unless the necessary identification data are provided to link questionnaire responses to student-retention and alumni follow-up data.

Student Affairs at the University administers Student Information Forms through its orientation program. Special directions accompanying the questionnaire ask each student to enter the social security number and group code for the college in which he/she matriculates. With the CIRP data tape downloaded into the Bernoulli Box database in the IBM-PC, the University is going to be able to incorporate Student Information Form data into its follow-up studies of the class entering in September, 1985.

STUDENT NEED/SATISFACTION SURVEYS:

In the spring of 1983, Planning and Institutional Research assisted a Student Affairs Task Force in the design and analysis of a student needs/satisfaction survey. A stratified-random sample of 800 full-time undergraduate students was invited to share their perceptions about the academic and social climate at the University. Sixty-two percent of the students returned usable questionnaires.

The content of the questionnaire included items about intellectual life, academic climate, academic advising, career counseling and placement, faculty and staff support, social activities, athletics, living and study facilities, student self-perceptions and observations about student peers.

An a priori classification of items was compared with the results of a factor analysis to gain a better understanding of the structure of the instrument. Cluster analysis was used to assess general levels of student satisfaction or dissatisfaction. Finally, discriminant analysis was used to identify issues on which different clusters of students agreed or disagreed in their levels of satisfaction.

Analyzed in this way, the results of the survey helped to clarify the diversity of student perceptions which exist among students who have different orientations toward the University.

Many significant differences were found in characteristics and perceptions of students among vocationally-oriented, academically-oriented, socially status-oriented students and alienated/disoriented students. We were encouraged by the levels of high satisfaction with the academic climate, and counseling services. However, we also learned that we have to find ways to deal with apparent dissatisfaction with the social climate and negative attitudes of some students towards their peers.

STUDENT FINANCIAL AID:

The University has to balance institutional pricing and student-aid policies at competitive levels, while at the same time assuring adequate income to maintain and improve the quality of its educational offerings. Students and parents make college choices based on net-cost after student-aid discounts. However, costs have to be balanced against the perceived value of academic programs and campus experiences at competitor institutions offering admission to common applicants.

With student-aid packaging software recently acquired from the College Board, the University will be able to model alternative assumptions and policies (e.g., institutional prices, family-contribution, financial-need and number and amounts of student-aid packages) to assess their likely impact on student enrollments, financial-aid budgets and enrollment income.

Using a four-year cumulative record of financial need and award data, descriptive statistics will be prepared using SPSSx to analyze the proportion of total student costs covered by family contribution, federal and state funds and University restricted and unrestricted aid funds. Using the record-selection features of SPSSx it is possible to produce such statistics for any given student sub-population and to provide comparative data among colleges within the University.

A financial-aid model is one of the components of the University's Enrollment/Financial Planning Model. The financial aid model is integrated with enrollment forecasts and institutional pricing. Historical data are maintained for financial need variables and both external and internal sources of student aid funds. Policies about the

number of students to assist and budget policies for student aid are balanced against policies about levels of financial aid and the percentage of student-aid discounting of tuition income.

STUDENT RETENTION:

Patterns of student retention are being studied using a cumulative record of credits and quality points for each entering-student cohort over four-year and six-year time periods.

The research design for student retention serves several purposes: 1) identify characteristic patterns of student enrollment, persistence and academic achievement; 2) describe the characteristics of students who follow each student-retention pattern; 3) predict student retention patterns and survival rates; and, 4) allow colleges to model hypotheses about student sub-groups expected to have high or low survival rates.

In the design, separate analyses are performed for each college, recognizing the wide variations among colleges in the patterns of student flow. Separate analyses are also conducted for freshmen and transfers because freshmen are more likely to accumulate a larger number of credits than transfers.

A cluster analysis is performed on the number of credits earned each semester and on the cumulative quality grade point average. Varying the number of clusters, we analyze differences in the patterns of persistence, withdrawal and dismissal and describe the characteristics of students clustered in each retention pattern. Discriminant analysis is then used with student descriptive data and traditional academic measures to derive prediction equations for estimating the likelihood that a student will follow a particular retention pattern.

A second method we are exploring to study student retention is survival analysis. Although the design and computation of survival analysis are complex, the outputs are descriptive and relatively easy to interpret. The criterion measure used in the survival analysis is cumulative credits earned (a surrogate for time of survival). The analysis produces a survival table which breaks down the number of students entering each interval, the cumulative percentage beginning the interval, and the number of students dismissed, withdrawn, graduated and

continuing. Separate survival tables and graphical displays are prepared for freshmen and transfers. Two survival-analysis curves can be overlaid to describe continuation, graduation, and withdrawal rates graphically. In the first survival analysis, withdrawn and graduating students are both coded "dead" and graduating students are coded "lost," i.e., censored from the analysis. Survival analysis in addition to drawing the survival curves, has the advantage of offering a step-wise logistic regression procedure for analyzing survival patterns for student subgroups.

INSTRUCTIONAL INCOME AND EXPENSE:

Another goal of the enrollment-management system is to find ways to balance enrollment demand, course offerings and staffing at reasonable economic levels in terms of direct instructional income and expense. The Office of Planning and Institutional Research has created a database and prototype analysis program which rolls up instructional income and expense from the section level to the position, course, department, college and University levels.

Salaries for full-time and adjunct faculty members are allocated to course sections proportionately on the basis of the number of course preparations. Student credit hours for each category of students (i.e., full-time/part-time, undergraduate/graduate) are multiplied times the cost per-credit hour to calculate enrollment income for each course section. Statistics provided in the report include enrollment head counts, student credit-hours, faculty workloads, student credit-hour production and the ratio of tuition income to allocated instructional expense.

Judgements about educational values and curriculum priorities, of course, have to be balanced against the economic issues of staffing, faculty workloads and the ratio of instructional income to salary expense. To the extent that enrollment cannot be managed through student recruitment or student retention, the University inevitably will be forced to reallocate positions, salaries, and courses among departments in order to respond to fluctuations in enrollment demand.

ALUMNI FOLLOW-UP:

Survey feedback from alumni is an essential element in any enrollment management program. To build a credible image and reputation as an academic institution, the University has to keep track of its alumni -- their goals and aspirations, their employment opportunities and career success, their cultural interests and achievements as lifelong learners, their valued contributions to organizations, professions or communities and their assessment of the quality of academic programs and campus experiences as undergraduates. The University does follow-up on the career placement of seniors, six months following graduation; and each college conducts periodic informal surveys of its alumni. However, this information is insufficient, the University really needs more comprehensive, systematic and continuous feedback from alumni. When the University implements its alumni/development system, efficient direct-mail and telephone surveys of alumni can be performed; and survey data can also be linked with student data for longitudinal alumni follow-up studies. Alumni follow-up questionnaires are available in abundance, developed for both national and institutional studies; these can be readily adapted on a selective basis to satisfy the University's enrollment management information needs.

CONCLUSION:

The University of Hartford has taken its first steps in building a flexible and responsive decision support system for enrollment management. Rapid progress in satisfying user requirements has been achieved by concentrating our development efforts on the integration of user-friendly, fourth-generation software tools. Prototyping enrollment management applications is a viable way for universities to keep abreast of external environmental trends, of changing information requirements, and of emerging DSS technology.

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